

The Affect of Application Volume and Deposition Aids on Droplet Spectrum and Deposition for Aerial Applications

Presented at
ASAE/NAAA Technical Session
38th Annual NAAA Convention
Silver Legacy Hotel and Casino
Dec. 6, 2004
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Biological and Agricultural Engineering

Paper # AA04-006

Objective:



The objective of this study was to evaluate the affect of deposition aids and application volume on droplet spectrum and canopy penetration for a fixed wing aerial application.

Materials and Methods:

- ✓ Soybean circle, Ingalls, KS
- ✓ August 30, 2004 (8:00-10:00 AM)
- ✓ Design 2 x 5 (10 treatments with 3 reps each)
- ✓ Products completely randomized
- ✓ All treatments parallel to the wind
- ✓ Soybeans were 36-46 inches tall
 - R6 growth stage and 90% canopy fill
- ✓ Application Conditions:
 - 58-70°F temperature
 - 77% average relative humidity
 - Wind speed:
 - Range = 5-11 mph
 - Average = 8.8 mph
 - Direction range = 170 - 210 degrees



Materials and Methods:

- ✓ AT 401W (Ingalls Aerial)
 - Walters Engine Conversion
 - Drop booms
 - CP-09 nozzles w/30° deflection
 - 3 GPA (35 nozzles)
 - 2/3 - .078 and 1/3 - .125
 - 1 GPA (33 nozzles) .062
 - 29 psi
 - Average speed 129 mph GPS measured
 - Medium droplets – USDA Worksheets
- ✓ Aircraft Operation S.A.F.E. calibrated
- ✓ Application Height 10-12 feet



Materials and Methods:

- ✓ 4 deposition aids:
 - Preference
 - Preference + Placement
 - Interlock + Preference
 - Interlock + Rivet
- ✓ Water used as a check
- ✓ Spray mixes containing 50 gal
 - NIS (Crop Oil Concentrate) @ 3 ounces/acre
 - Tap water
 - Required amount of product or combination of products per label
- ✓ Application volumes
 - 3 GPA
 - 1 GPA

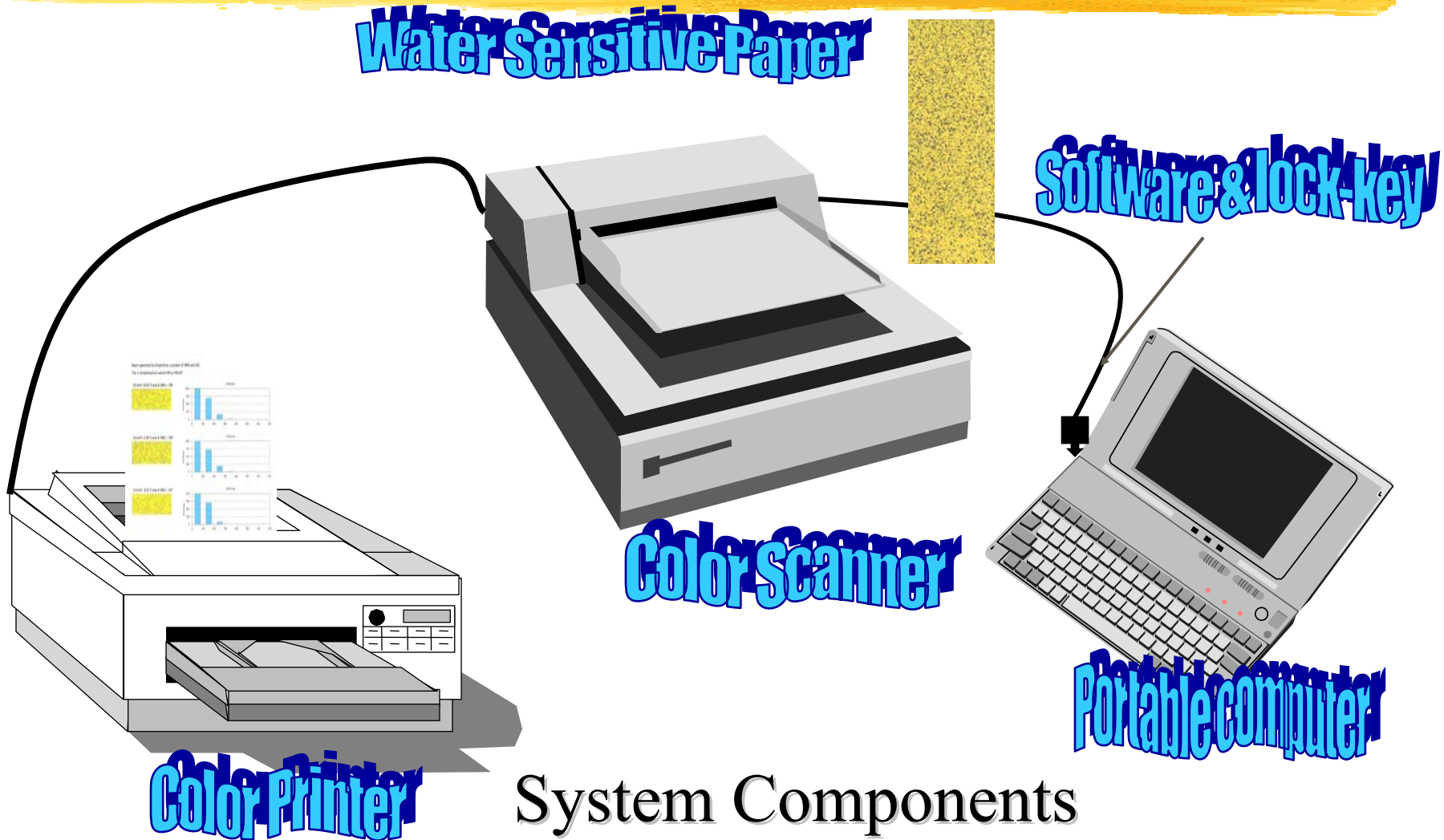


Collection Procedure for canopy:

- ✓ 1 pass
- ✓ 7 collectors evenly spaced across the swath width
- ✓ 3 kromekote papers on each collector
- ✓ placed in top, middle, and bottom of canopy = 21 papers
- ✓ 4 papers in non canopy area



DropletScan™ used to analyze droplets:



Analysis Procedure:

- ✓ Scanned and recorded
 - 630 canopy papers (7 x 3 x 10 x 3)
 - 120 outside canopy (4 x 10 x 3)
 - VMD and % Area Coverage
- ✓ Statistical analysis with SAS
 - Proc GLM
 - LS Means compared
- ✓ Alpha = .10



Results and Discussion:



- ✓ Comparison of locations in canopy
- ✓ Comparison of application volume
- ✓ Assessment of Droplet Spectra
- ✓ Comparison of products

LS Means and rank: (percent area coverage all positions)

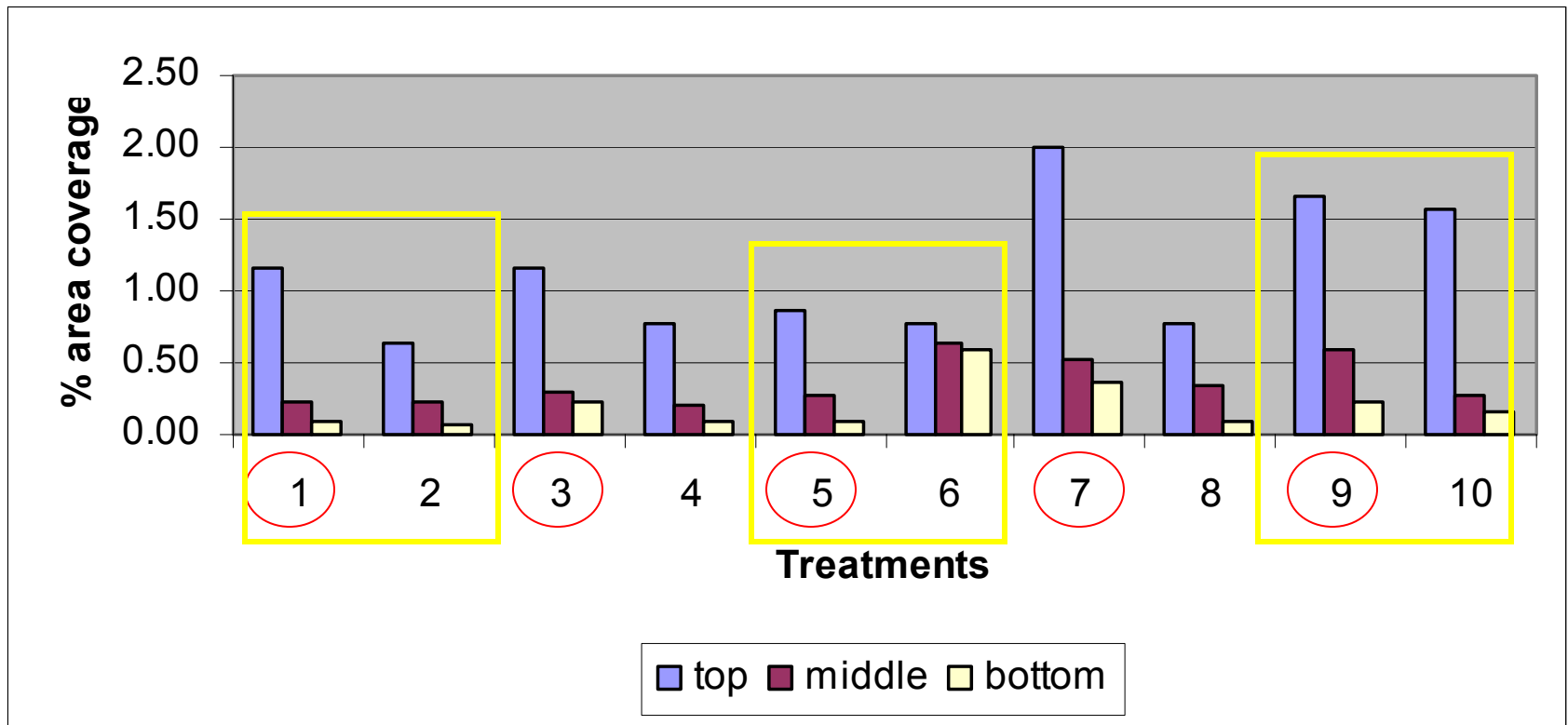
Treatment ¹	Top ²	Rank	Middle	Rank	Bottom	Rank	No Canopy	Rank	VMD	Rank
1	1.17 ^a	5	0.23 ^b	Tie 8	0.10 ^b	Tie 6	2.80 ^a	4	300 ^a	5
2	0.63 ^d	10	0.23 ^b	Tie 8	0.07 ^b	10	1.76 ^b	10	293 ^a	7
3	1.17 ^a	4	0.30 ^a	5	0.23 ^a	Tie 3	5.07 ^a	1	334 ^a	1
4	0.77 ^c	Tie 7	0.20 ^c	10	0.10 ^b	Tie 6	2.40 ^a	8	254 ^b	10
5	0.87 ^b	6	0.27 ^a	Tie 6	0.10 ^b	Tie 6	2.50 ^a	7	300 ^a	4
6	0.77 ^c	Tie 7	0.63 ^a	1	0.60 ^a	1	2.53 ^a	6	282 ^a	8
7	2.00 ^a	1	0.53 ^a	3	0.37 ^a	2	4.60 ^a	2	327 ^a	2
8	0.77 ^c	Tie 7	0.33 ^a	4	0.10 ^b	Tie 6	1.83 ^b	9	299 ^a	6
9	1.67 ^a	2	0.60 ^a	2	0.23 ^a	Tie 3	2.70 ^a	5	279 ^a	9
10	1.57 ^a	3	0.27 ^a	Tie 6	0.17 ^a	5	3.33 ^a	3	311 ^a	3
Average	1.14		0.36		0.21		2.95		298	

 Red circle represents 3 GPA treatments

¹See table 1 for description of products used in each treatment.

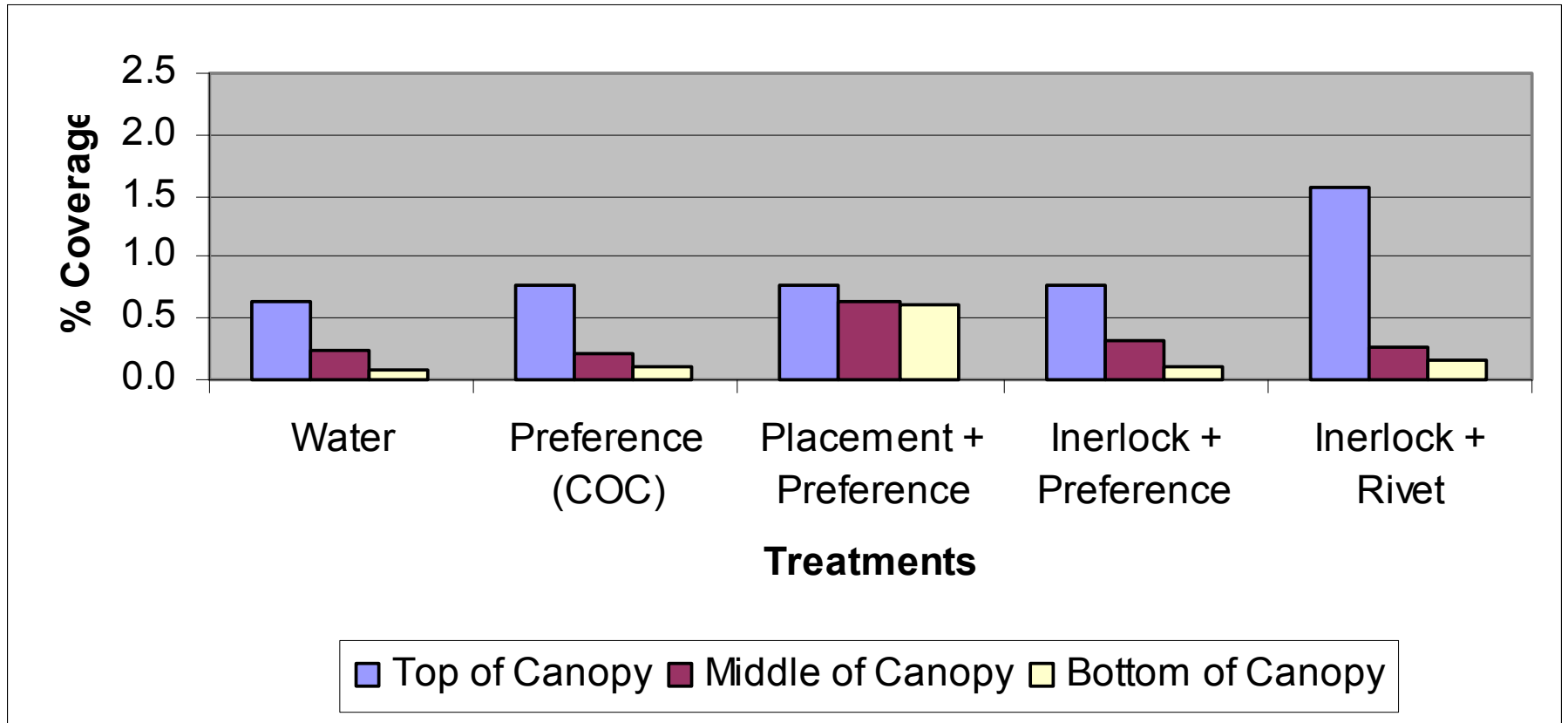
²Means with the same letter are not significantly different.

Percent area coverage all positions:

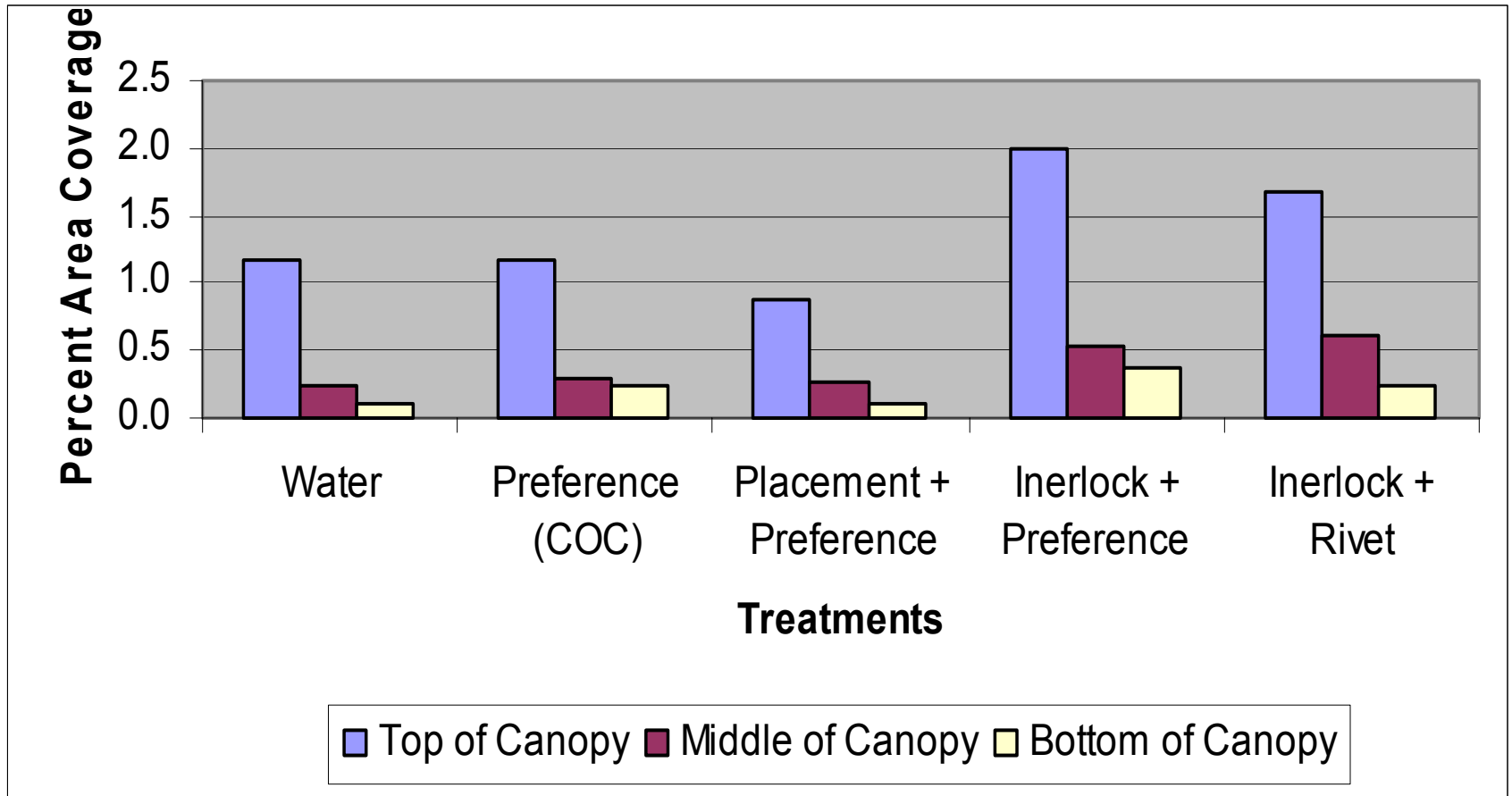


1 & 2 = Water 3 & 4 = Preference 5 & 6 = Placement/Preference
7 & 8 = Interlock/Preference 9 & 10 = Interlock/Rivet

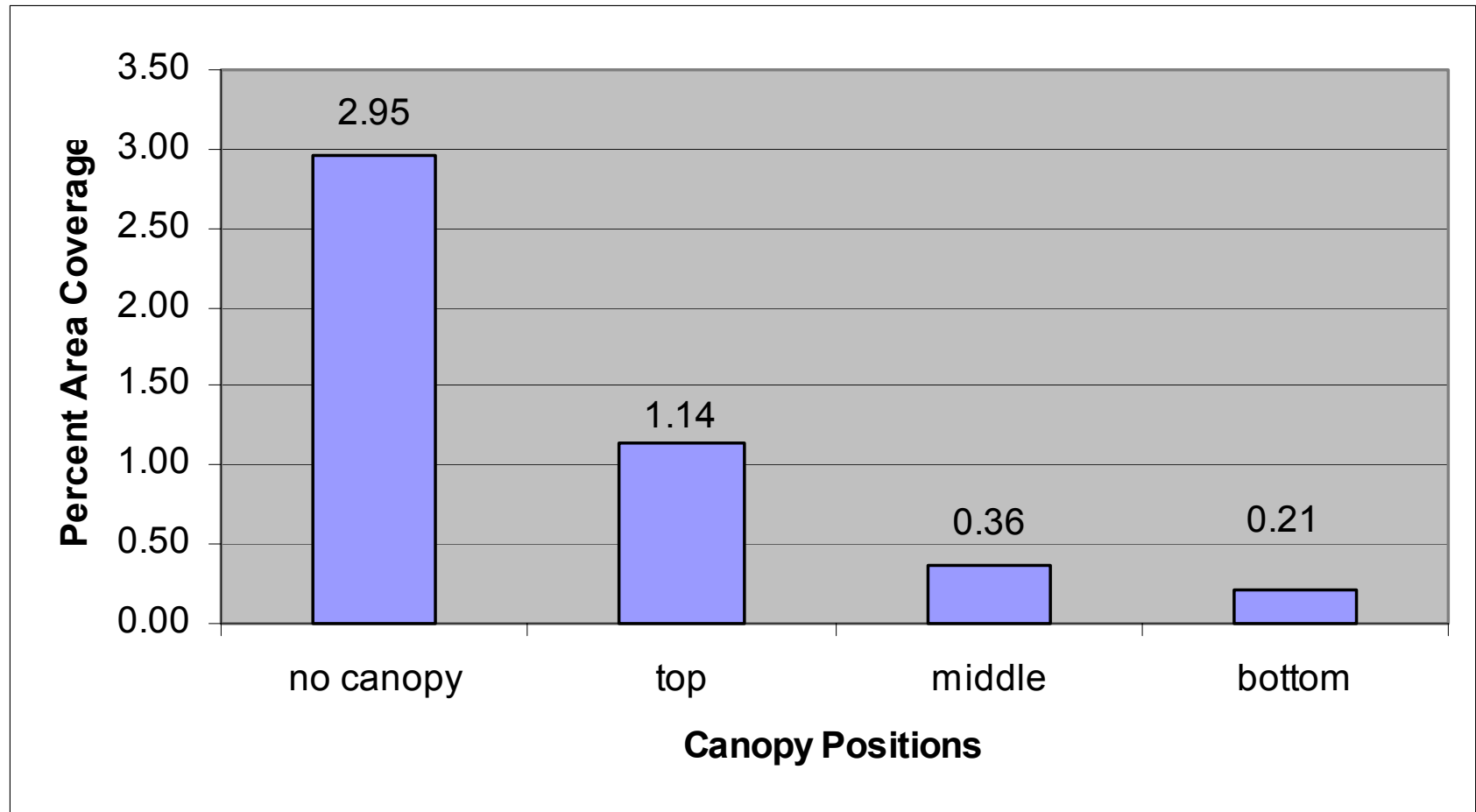
Coverage at 1 GPA:



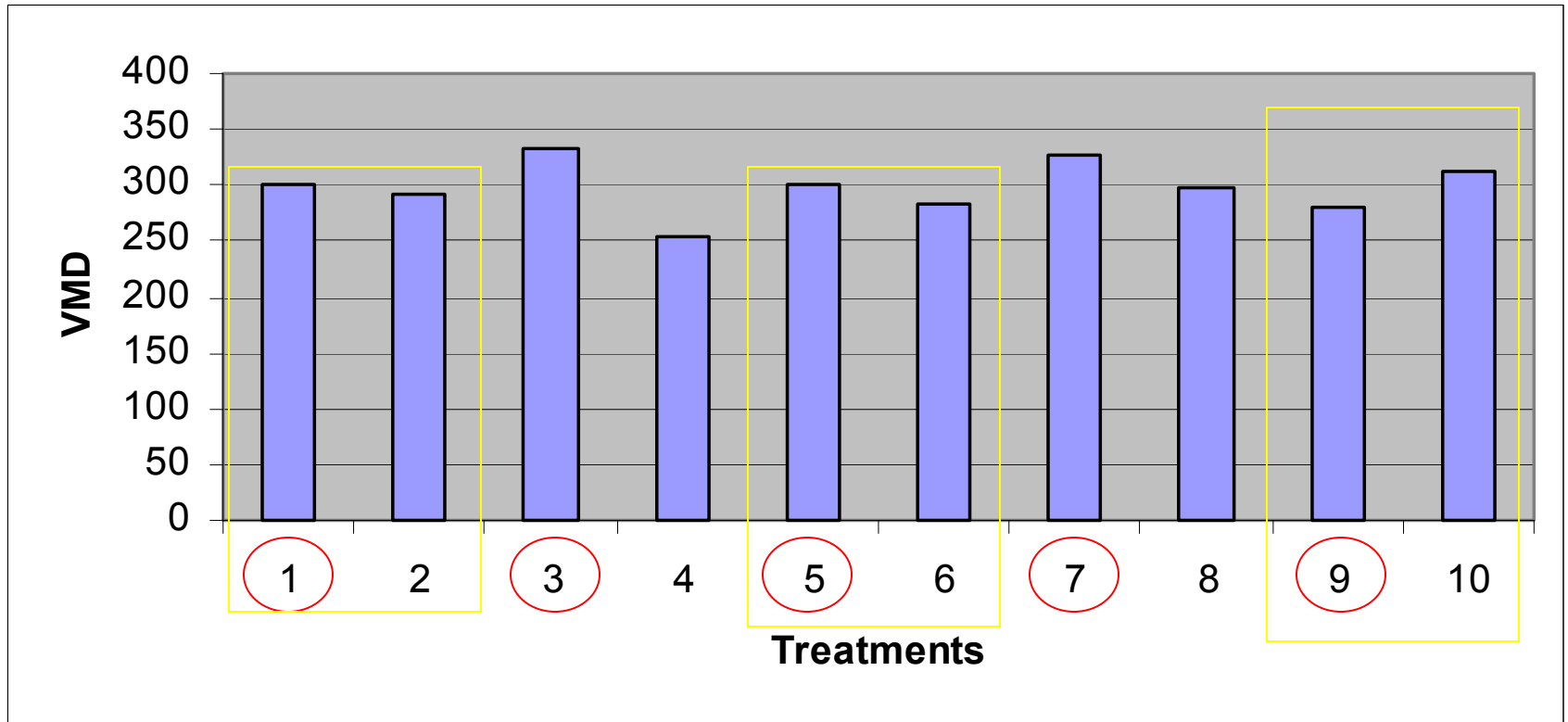
Coverage at 3 GPA:



Average Coverage All Positions:

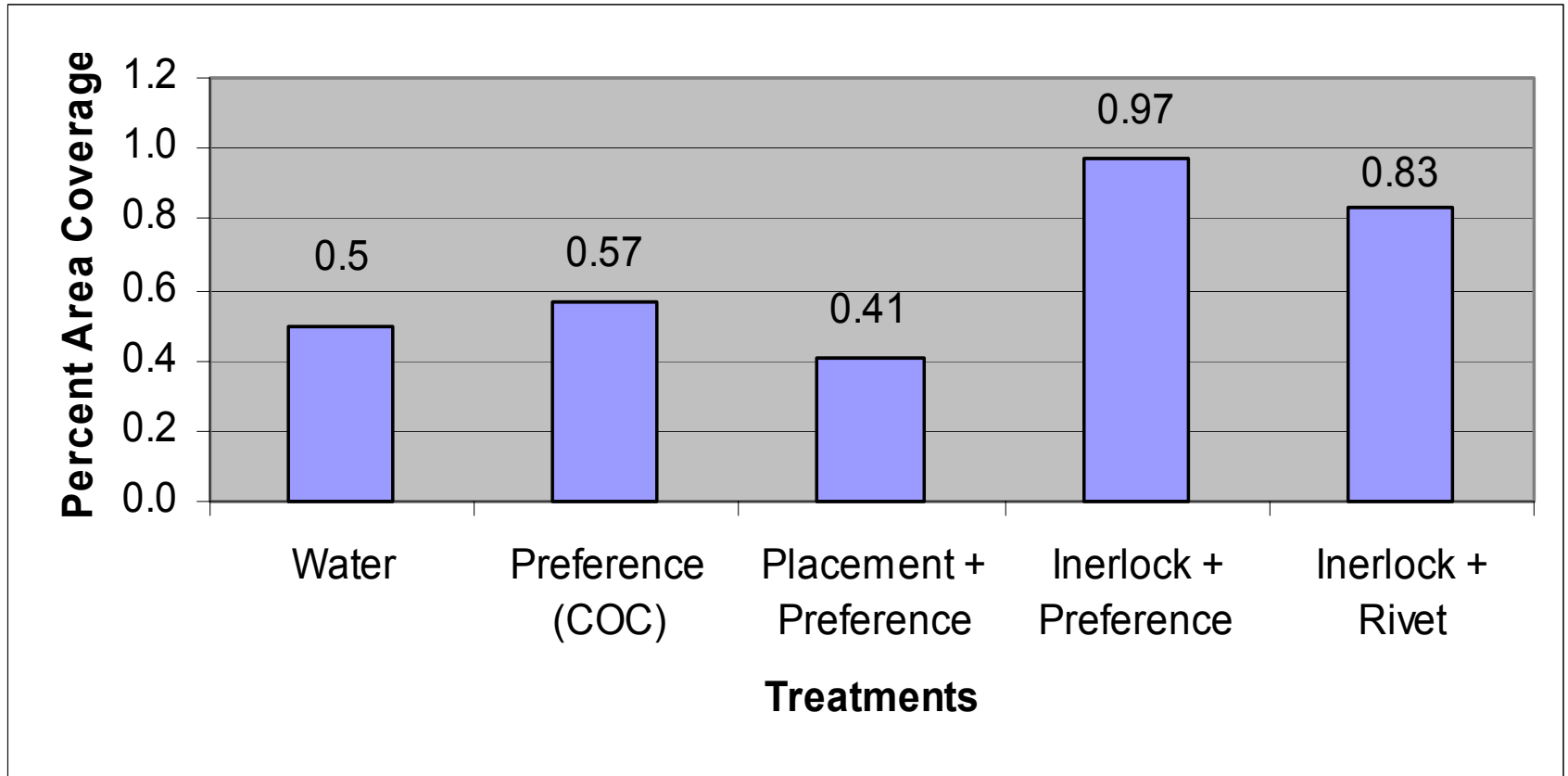


VMD for No Canopy Collections:



1 & 2 = Water 3 & 4 = Preference 5 & 6 = Placement/Preference
7 & 8 = Interlock/Preference 9 & 10 = Interlock/Rivet

Average Coverage Across Canopy Position at 3 GPA*



*sum of top, middle, and bottom averaged

Summary of findings:



- ✓ Top of canopy had highest coverage.
- ✓ Canopy reduced coverage by 3 times.
- ✓ 3 GPA had more canopy coverage than 1 GPA.
- ✓ Droplet spectra slightly influenced - larger.
- ✓ Deposition aids increased canopy penetration.
- ✓ Product differences were measured.
- ✓ Highest coverage - Interlock and Preference.

Acknowledgements:

- Agriliance
- Ingalls Aerial
- Tom Miller
- Brian Oyler

Thank you!

Field Test Comparisons of Drift Reducing Products for Fixed Wing Aerial Applications

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Abstract

Twenty-one drift control products were compared for reducing horizontal and vertical drift for fixed wing aerial applications. Water-sensitive paper and DropletScan™ software was used to collect and compare the differences in drift.

- A low-score performance value at the low wind profile (6.8 Km/h) was used to rank each products ability to reduce drift.
- A few of the products exhibited less drift potential than water alone. Several of the products exhibited the same or more drift potential than water alone.
- Products C and P had the lowest amount of horizontal drift with the Air Tractor with H being the lowest for the Cessna.
- In the vertical profile product C and T had the least drift for the Air Tractor and L had the least drift for the Cessna.

Equipment and Products

- ✓ AT 502A
 - Drop booms
 - CP-09 nozzles w/5° deflection
 - Combination of .078 and .125 orifice settings
 - 276 kPa (40 psi)
 - 241 km/h (150 mph ground speed by radar)
- ✓ Cessna 188 Ag Husky
 - Ag Tips
 - CP-03 w/30 degree deflection
 - Combination of .078 and .125 orifice settings
 - 179 kPa (26 psi)
 - 185 km/h (115 mph ground speed by radar)
- ✓ Aircraft calibrated for 28 L/ha (3 GPA)

Table 1. Product codes, companies, and mixing rates.

Product Code	Product Name	Product Company ¹	Suggested Mixing Rate ²	Mixing Rate/ 80 Gallon Load ²
A	Formula One	United Suppliers	3 qt/100 gal	1.8 quarts
B	HM0226	Helena	1% v/v	76.8 ounces
C	AMS 20/10	United Suppliers	10 lb/100 gal	6 pounds
D	Border EG 250	Precision Labs	10 oz/100 gal	169.8 grams
E	Control	Garco Products	4 oz/100 gal	2.4 ounces
F	INT VWX	Rosen's	15 lb/100 gal	9 pounds
G	Inplace	Wilbur-Ellis	8 oz/acre	1.25 gallons
H	Garco #3	Garco Products	8 oz/100 gal	4.8 ounces
I	INT YAR	Rosen's	9.0 lb/100 gal	5.4 pounds
J	Border Xtra 8L	Precision Labs	2.5% v/v	192 ounces
K	HM 2005C	Helena Chemical	9 lb/100 gal	5.4 pounds
L	Double Down	United Suppliers	2.5 gal/100 gal	1.5 gallons
M	Liberate	Loveland Industries	1 qt/100 gal	19.2 ounces
N	Target LC	Loveland Industries	2 oz/100 gal	36 ml
O	HM 2052	Helena Chemical	1% v/v	76.8 ounces
P	INT HLA	Rosen's, Inc	2 lb/100 gal	1.2 pounds
Q	HM 0230	Helena Chemical	0.5% v/v	38.4 ounces
R	Valid	Loveland Industries	1 pt/100 gal	288 ml
S	Tap Water	Goodland, KS		
S2	Tap Water	Goodland, KS		
T	41-A	San-Ag	2 oz/100 gal	34.05 grams

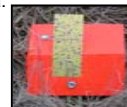
¹As of Dec. 2002

²All tank mixes including water treatments contain X-77 at .25% v/v

Conclusions:

- Differences in products are shown at all horizontal and vertical collector positions.
- Products A, Q, G, F, D, R, O, and K all tallied higher performance scores than water for the Air Tractor on the horizontal collectors. Products A, R, Q, O, J, I, L, G, M, B, N and K were higher for the Cessna.
- For the vertical profile, products K, D, Q, R, and O and products I, B, J, C, and K were higher than water for the Air Tractor and Cessna respectively.
- Products C and P had the lowest amount of horizontal drift with the Air Tractor with H being the lowest for the Cessna.
- In the vertical profile product C and T had the least drift for the Air Tractor and L had the least drift for the Cessna.

Figure 3. Horizontal collector with water-sensitive paper.



Drift Collector

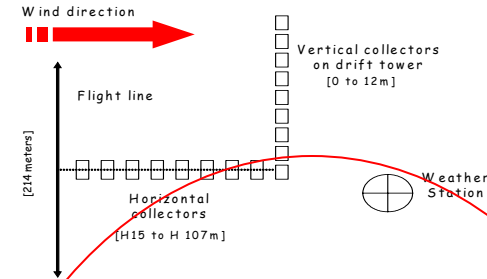


Figure 4. Vertical collection tower.

Results: Low-Score Performance Rank

- A low-score performance value was tabulated for each product at all horizontal and vertical collector positions for each airplane.
- Score was based on lowest drift amount at the low wind profile.

Table 2. Final rank of each product for horizontal drift.

Air Tractor				Cessna			
Product	Code	Point Total	Rank ²	Product	Code	Point Total	Rank ²
AMS 20/10	C	9	Tie 1	GARCO #3	H	18	1
INT HLA	P	9	Tie 1	CONTROL	E	28	2
GARCO #3	H	31	3	DOUBLE DOWN	L	31	3
CONTROL	E	32	4	INT HLA	P	37	Tie 4
DOUBLE DOWN	L	48	5	41-A	T	37	Tie 4
41-A	T	50	6	INT VWX	F	39	6
INT YAR	I	63	7	BORDER EG 250	D	62	7
BORDER XTRA 8L	J	64	8	TAP WATER ³	S	64	8
HM0226	B	71	9	FORMULA ONE	A	66	9
LIBERATE	M	73	10	VALID	Q	68	10
TARGET LC	N	77	11	HM 0230	O	70	11
TAP WATER ³	S	78	12	HM 2052	O	72	12
FORMULA ONE	A	80	13	BORDER XTRA	J	83	13
HM 0230	Q	91	14	INT YAR	I	92	14
INPLACE	G	94	15	AMS 20/10	C	102	15
INT VWX	F	101	16	INPLACE	C	104	16
BORDER EG 250	D	104	17	LIBERATE	M	109	17
VALID	R	119	18	HM0226	B	116	18
HM 2052	O	120	19	TARGET LC	N	119	19
HM 2005C	K	122	20	HM 2005C	K	137	20

¹Rank based on low-score performance value totals for each product at all horizontal positions.

²1 = lowest drift.

³Tap water used as a base line for separating differences.

Table 3. Final rank for each product for vertical drift.

Air Tractor				Cessna			
Product	Code	Point Total	Rank ²	Product	Code	Point Total	Rank ²
AMS 20/10	C	20	1	DOUBLE DOWN	L	30	1
INT HLA	P	21	2	INT VWX	F	40	2
INT HLA	P	43	3	CONTROL	E	45	3
DOUBLE DOWN	L	52	4	GARCO #3	H	48	4
FORMULA ONE	A	59	5	41-A	T	51	5
GARCO #3	H	60	6	HM 0230	Q	55	6
TARGET LC	N	69	7	FORMULA ONE	A	66	7
HM0226	B	75	8	VALID	R	87	8
INPLACE	G	88	9	INT HLA	P	90	9
BORDER XTRA 8L	J	92	10	HM 2052	O	97	10
CONTROL	E	100	11	TARGET LC	N	102	11
INT YAR	I	104	12	INPLACE	C	103	12
LIBERATE	M	105	13	BORDER EG 250	D	105	13
INT VWX	F	110	14	LIBERATE	M	108	14
TAP WATER ³	S	113	15	TAP WATER ³	S	116	15
HM 205C	K	129	16	INT YAR	I	122	16
BORDER EG 250	D	132	17	HM0226	B	123	17
HM 0230	Q	147	18	BORDER XTRA 8L	J	141	18
VALID	R	164	19	AMS20/10	C	155	19
HM 2052	O	180	20	HM 2005C	K	180	20

¹Rank based on low point summary for each product at all horizontal positions.

²1 = lowest drift.

³Tap water used as a base line for separating differences.

Introduction

Off-target drift is a major source of application inefficiency. Application of crop protection products with aerial application equipment is a complex process. In addition to meteorological factors, many other conditions and components of the application process may influence off-target deposition of the applied products. Spray formulations have been found to affect drift from aerial applications. Materials added to aerial spray tank mixes that alter the physical properties of the spray mixture affect the droplet size spectrum. With new nozzle configurations and higher pressure recommendations, and with the continued development of drift reducing tank mix materials, applicators seek to better facilitate making sound decisions regarding the addition of drift control products into their tank mixes.

Objective

This study evaluated the influence of selected drift control products/deposition aids on horizontal and vertical spray drift during two selected fixed wing aerial application scenarios.



Figure 1. Cessna 188 Ag Husky.



Figure 2. Air Tractor 502A.